# The SNO $^3$H$(p,\gamma)^4$He 19.8-MeV $\gamma$-Ray Source

*A. W. P. Poon, Y. Kajiyama, K. T. Lesko, Y. D. Chan, X. Chen, M. Dragowsky, A. D. Marino, E. B. Norman, C. E. Okada, and R. G. Stokstad*

The SNO collaboration needs a high energy calibration point beyond the $^8$B solar neutrino energy endpoint of ~15 MeV. This calibration point is very important in understanding the detector's energy response because Čerenkov light production is not exactly linear in energy (e.g. energy loss to low energy electrons below the Cĕrenkov threshold). As the energy increases, the probability that a photomultiplier tube would get hit by more than one Čerenkov photon increases. Therefore, a calibration point beyond the solar neutrino endpoint will provide vital information on this multiple hit effect.

We have devloped the "$pT$" source (Figure 1), which employs the $^3H(p,\gamma)^4He$ reaction to generate 19.8-MeV gamma rays. This $pT$ source is the first self-contained, compact, and portable high energy gamma-ray source ($E_\gamma$ >10 MeV).

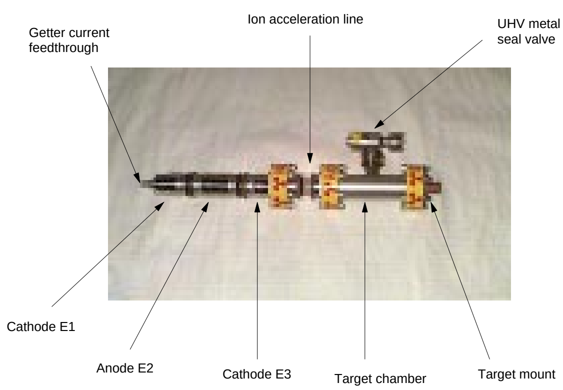


Figure 1: The SNO $pT$ Source. The permanent magnet for providing the axial field in Penning discharge is not shown this figure.

The source can be divided into three sections: the gas-discharge line, the ion acceleration line and the target chamber. The gas-discharge line is a cold-cathode Penning ion source. A zirconium-vanadium-iron alloy getter is used as the hydrogen discharge gas reservoir. The ion acceleration line is a double-ended glass adapter, with one end attached to the gas-discharge line and the other connected to the target chamber which is biased at a negative high voltage (~-30kV). A tritium target, which is a scandium tritide film evaporated on a molybdenum substrate, is mounted at the end of the beam line. The target has a radioactivity of about 4 Ci.

We are in the final preparation phase of deploying the $pT$ source. The deployment capsule for the source is being fabricated, and we anticipate to have the first run in SNO in Spring 2000. Figure 2 shows the simulated energy spectrum of the $pT$ source.

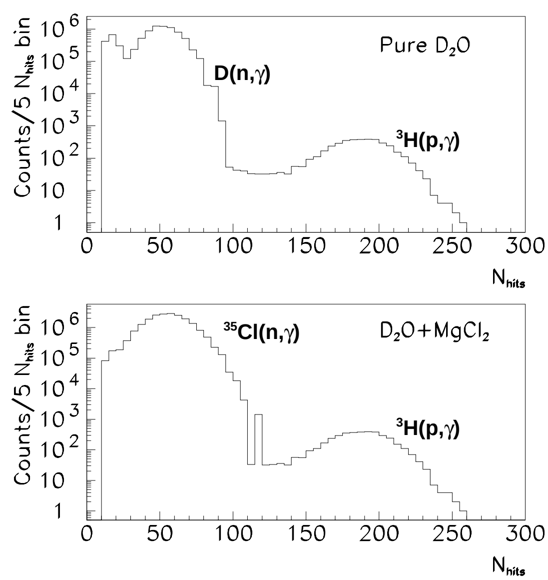


Figure 2: Simulated detector response to neutrons and $\gamma$'s that are generated by the $pT$ source. The peaks below the $pT$ photopeak are $\gamma$'s from neutron capture by the deuteron in the heavy water run scenario, or by $^{35}$Cl in the "salt" run scenario. The abscissa value is the number of PMT hits in the SNO detector.